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Rewarding responsible innovation when consumers are distant from producers: evidence from New Zealand

Special issue: Responsible innovation in the agri-food sector

RESEARCH ARTICLE

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Abstract

The concept of 'responsible innovation' is the subject of an expanding literature. As Vincent Blok and colleagues have recently analysed, practical issues undermine the adoption of responsible innovation in industry. These issues are intensified for agri-food producers who export a large proportion of their production to distant consumers, as is the situation in New Zealand. Even in this case, however, this study reports evidence that final consumers of agri-food products in five of New Zealand's key export markets value credence attributes produced by responsible innovation and that this has the potential to increase returns to the country's domestic producers. A national movement of New Zealand agribusiness leaders is pursuing this vision, but further research is needed to understand how responsible innovation can operate in global agribusiness value chains.

Keywords: credence attributes, agri-food, exports, New Zealand

JEL code: F14, Q13, Q17

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1. Introduction

The concept of 'responsible innovation' is the subject of an expanding literature exploring its opportunities and limitations; see, for example, Owen *et al.* (2013), Van den Hoven *et al.* (2014), Koops *et al.* (2015) and Pellé and Reber (2016), as well as section 2 of this paper. A strong impetus has been the European Commission's Responsible Research and Innovation (RRI) theme (Owen *et al.*, 2012: 751-754), which aims that 'societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society' (European Commission, 2012a: 2). Consequently, RRI has been a cross-cutting issue in the European Union's €80 billion Horizon 2020 programme. Attention is also beginning to be paid to the adoption of responsible innovation in industry (see, for example, Scholten and Blok, 2015, and Iatridis and Schroeder, 2016), although a recent study of large agribusinesses in the Dutch food industry reports that 'innovative food companies are still far from implementing the ideal of mutual responsiveness in a significant way' (Blok *et al.*, 2015: 147; De Hoop *et al.*, 2016). Blok *et al.* (2015: 162) further found that where companies do engage with stakeholders, it is mainly in the first phase of innovation and occurs principally at a strategic level. Their study identified specific factors that inhibit greater engagement, three of which were highlighted and discussed in greater detail by Blok and Lemmens (2015). These were: (1) fundamental differences among diverse and multiple stakeholders about the vision and goals of responsible innovation; (2) incentives for agribusinesses to maintain their competitive advantages arising from knowledge not shared with competitors or other stakeholders; and (3) limited human abilities to predict all consequences of any particular innovation process, leaving open the possibility of unintended harm.

This paper addresses these inhibiting factors using the example of agri-food exporters from New Zealand. As in Europe, there are strong pressures for responsible innovation in that country's primary sector; Federated Farmers of New Zealand, for example, recognises 'the challenge of maintaining the social licence to farm in New Zealand in the 21st Century' (Rolleston, 2015). Nevertheless, as will be explained in this paper, the three issues highlighted by Blok and Lemmens (2015) are intensified in the New Zealand case by the large distances (geographic and cultural) between domestic producers and overseas consumers.¹ Rolleston (2015) and others have therefore cautioned that the primary sector's contribution to national economic wellbeing would be handicapped if unrealistic expectations for responsible innovation increase the costs of production to an extent that harm the competitiveness of New Zealand agri-food exports in international markets.

Section 2 reviews the current literature on responsible innovation, paying particular attention to the issue of public values. The New Zealand context is explained in more detail in Section 3 which also introduces the science questions addressed in this research. Section 4 describes the methodologies used, which include surveys of consumers in five key markets for New Zealand agri-food exports, with each survey incorporating a choice experiment used to generate econometric data for analysis in an international trade model. Results from the five surveys are presented in Section 5. Results from the choice experiments and trade analysis are presented in Section 6. Section 7 discusses these results. It accepts the difficulties identified by Blok *et al.* (2015) and Blok and Lemmens (2015), but argues on the basis of the evidence reported in sections 5 and 6 that it is possible – although not easy – to reward responsible innovation in primary sector industries, even when final consumers are distant from a country's domestic producers. Section 8 offers a brief conclusion.

2. Responsible innovation and values

The literature on responsible innovation (at least under that title) is relatively young, but has grown dramatically. A review by De Saille and Mevecky (2016: 3-4) reports that the number of peer reviewed publications on this topic doubled every year from 2012 to 2014 and looked likely to double again in 2015, assisted by the

¹ New Zealand's location intensifies, but does not cause, the issues discussed in this paper. We do not suggest, for example, that it is always geographic distance that influences the problem of inclusion and engaging multiple stakeholders. New Zealand is chosen not as a special case, but as an example where the problems identified by Blok and Lemmens have particular force. Hence the study's evidence of potential rewards in the form of higher returns for responsible innovation has general relevance.

launch of the 'Journal on Responsible Innovation' by Taylor and Francis in 2014 (Guston *et al.*, 2014). The concept has been adopted in science policy. In the Netherlands, for example, the Dutch Research Council has sponsored a research programme on research innovation since 2009 (Van den Hoven, 2014) and the review by Owen *et al.* (2012) describes its emergence as a strong influence in the European Commission's Science in Society programme within the Horizon 2020 Strategy.

An often-cited definition by Von Schomberg (2013: 63, 2014: 39) describes responsible research and innovation as 'a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)'. Owen *et al.* (2012) cite this definition and build on it to suggest three emerging features of responsible research and innovation:

1. Science for society: democratising the governance of intent.
2. Science with society: Institutionalising responsiveness.
3. Reframing responsibility.

The first feature calls for the targets for innovation to be the subject of an ethical, inclusive, democratic and equitable process (Nathan, 2015). The second feature emphasises imbedded institutions for reflection, anticipation and inclusive deliberation on the processes and outcomes of research and development (De Hoop *et al.*, 2016; Foley *et al.*, 2016). The third feature requires science providers, science users, science policy-makers and science funders to broaden their respective responsibilities for addressing big moral issues associated with innovation (Valdivia and Guston, 2015). Pellé and Reber (2015) have explored what 'responsibility' might mean in this context, recognising that the word is understood in different ways by different people in different parts of the innovation system.

A key aspect of the responsible innovation approach is the intention to align scientific endeavour with wider public values. As noted in the introduction above, for example, the European Commission (2012a: 2) writes: 'responsible research and innovation means that societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society.' Indeed, Taebi *et al.* (2014) suggest that responsible innovation is an endorsement of relevant public values, and their article explores how this principle can operationalised, especially 'since values emerge and evolve during the development and implementation of technologies' (Taebi *et al.*, 2014: 118). Thus, they recommend ongoing interdisciplinary research to extract values from the always-rich public debate and to identify potential value conflicts, finishing with four challenging questions:

1. How should the interdisciplinary research be performed?
2. How and when to extract public values?
3. Which opinions should count?
4. How should trade-offs be facilitated?

These questions have important implications for industry. To be profitable, commercial enterprises must deliver value to their customers. Hence, there are strong incentives for a business to satisfy the personal and social values of the final consumers of its product or service. An illustrative example of the commercial penalty when this does not happen is the negative consequences for the Argentinian Ovis 21 collaborative in the fashion textile industry when People for the Ethical Treatment of Animals (PETA) posted a video in August 2015 showing animal cruelty on one of its establishments (Gardetti, 2017). In June 2016, a new Responsible Wool Standard was released, involving audited certification of farmers meeting their obligations to respect the land and ensure five freedoms for their animals to meet the trust of consumers (Textile Exchange, 2017).

In the literature on global agri-food value chains, product attributes such as animal welfare, environmental sustainability, social responsibility and cultural authenticity are termed 'credence attributes', since their veracity has to be taken on trust by the consumer at the point of purchase. A large number of studies show how market access or price premiums can be increased by marketing credence attributes valued by consumers. Recent

examples include Grunert *et al.* (2014), Lagervist and Hess (2011), Liu *et al.* (2013), Miller *et al.* (2015), Ortega *et al.* (2012), Toma *et al.* (2012), Tonsor (2011) and Wang (2013). Thus, responsible innovation that aligns with public values in a commercial setting has the potential to be rewarded by higher returns or greater market share. Nevertheless, as the introduction to this paper discussed, there are countervailing forces (Blok and Lemmens, 2015), which are particularly relevant for New Zealand agri-food exporters.

3. The New Zealand context

New Zealand has some unusual features compared to other developed economies. Among the 36 countries in the Organisation for Economic Cooperation and Development (OECD), for example, New Zealand has the seventh lowest ratio of exports to gross domestic product (29% in 2014; OECD, 2016), but the share of agri-food products in merchandise exports is very high (72% in 2014; Saunders *et al.*, 2016a: 1). Further, domestic policymakers recognise that New Zealand faces particular economic challenges because of its small domestic population and its long distance from the world's high income markets (Dalziel and Saunders, in press; Treasury, 2014: 16). A small population means the country's primary production is focused on exports, as shown in Figure 1, but long geographic distances from major markets create an unusually pronounced separation between producers and consumers.

Another unusual feature is that agri-food production and processing contributes 12% of its gross domestic product, while this sector's demand for inputs from other industries accounts for a further 7% (Saunders *et al.*, 2016a: 16). Thus, nearly 20% of the New Zealand economy is due directly or indirectly to the agri-food sector. Consistent with this importance, the country's public science has long been weighted towards the primary sector (New Zealand Government, 2015: 17). Science-led innovation has contributed to strong growth in the sector's productivity (Hall and Scobie, 2006), but as acknowledged by Federated Farmers, 'the continued development and intensification of agriculture [is] pushing up against environmental constraints' (Rolleston, 2015). This has led the government to fund a large-scale National Science Challenge named Our Land and Water, which aims 'to enhance primary sector production and productivity while maintaining and improving our land and water quality for future generations' (Joyce, 2013).

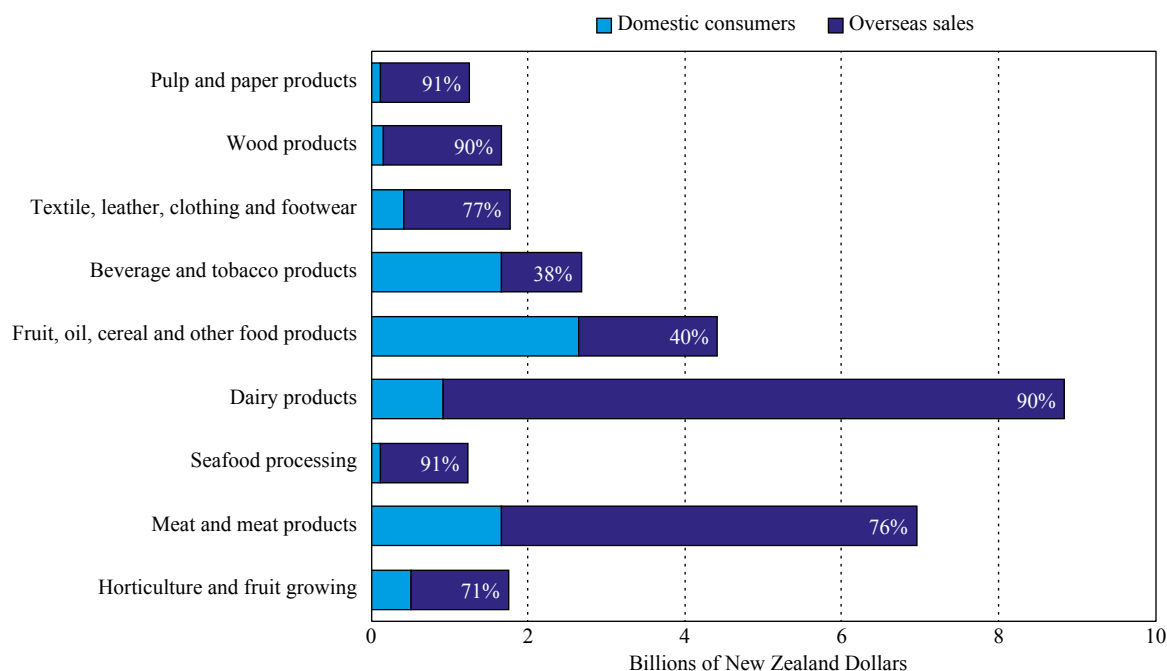


Figure 1. Value of New Zealand agri-food final sales and share that is exported, 2006/07 (adapted from Saunders *et al.*, 2016a: 20; Statistics New Zealand, 2012).

The focus on future generations in that objective is an example of the responsible innovation approach being applied to industry. Iatridis and Schroeder (2016: 1), for example, use very similar language in their stated expectation that 'responsible researchers and innovators achieve progress (and profits) without damaging the prospects of current and future populations'. This may seem unexceptional; as Stilgoe (2013: xv) has asked, who would wave a flag for irresponsible stagnation? Nevertheless, there are inhibitors to the take-up of responsible innovation by agri-food producers in New Zealand, for two major reasons (Rolleston, 2015). First, public views may be unduly influenced by non-scientific and non-representative campaigns that create a false impression among an urbanised population with little understanding of land-based production. Second, unreasonable and unsound regulations are likely to increase production costs, which may affect the industry's viability. These concerns are exacerbated in New Zealand because of the separation between pressures for responsible innovation (led by local citizens) and the revenue that can be earned (constrained by the willingness-to-pay of overseas consumers).

In that context, consider the issues analysed by Blok and Lemmens (2015). Although based on a Netherlands case study, their three inhibitors listed in the introduction to this paper are relevant for New Zealand agri-food producers. First, differences between producers and consumers about responsible innovation goals may be more pronounced across large geographic and cultural distances. Second, domestic agribusinesses competing into the same distant markets may be more motivated to maintain competitive advantage based on unshared knowledge. Third, exporters operating from the South Pacific may find it more difficult to predict how a local innovation will be perceived, or even noticed, by consumers in Northern Hemisphere markets. Thus, the analysis of Blok and Lemmens (2015) adds weight to concerns expressed in New Zealand that demands for responsible innovation might raise domestic production costs to an extent that could compromise competitiveness in international markets (Rolleston, 2015).

As explained in the previous section, increased production costs might be justified if the responsible innovation can add value to the consumption experience for which a consumer is willing to pay a premium. Thus, if responsible innovation creates higher-quality credence attributes (such as greater environmental sustainability), this may be funded through greater market share or higher returns. This study tests that possibility in two steps. First, if New Zealand production and processing systems can claim scientifically validated credence attributes, are these attributes valued by its international consumers? Second, if these attributes are valued, would the associated increase in consumer willingness-to-pay increase returns to domestic producers in New Zealand? The first research question was addressed using surveys of final consumers in five key markets for New Zealand exports. The second research question was addressed using data from choice experiments embedded in the surveys to undertake a scenario analysis in a partial equilibrium agricultural trade model disaggregated to focus on New Zealand's major agri-food exports. These methods are explained in more detail in Section 4.

4. Research methodology

Drawing on the credence attributes literature mentioned in the previous section, the researchers in June 2014 designed pilot surveys for three developed countries (Japan, Korea and the United Kingdom) and three developing countries (China, India and Indonesia). Results from those pilot surveys have been previously reported (Saunders *et al.*, 2015) and were then developed further in March and April 2015 to undertake surveys of 1000 middle-class consumers in five markets: China, India, Indonesia, Japan and the United Kingdom. These markets are all important for New Zealand agri-food exports. Following the signing of the New Zealand-China Free Trade Agreement on 7 April 2008, for example, dairy exports from New Zealand to China increased from NZ\$521 million² in 2008 to NZ\$4,326 million in 2014 (Saunders *et al.*, 2016a: 23). India presents promising trade opportunities for New Zealand (New Zealand Government, 2011). Indonesia and Japan are good examples of a developing and a developed country in Asia with strong trade connections to New Zealand. New Zealand has a long history of trade with the United Kingdom (Dalziel and Lattimore,

² 1NZ\$ = 0.75 US\$, calculated on the basis of the exchange rate on July 31, 2017.

2004: 19-20), which was therefore included to act as a familiar benchmark. The chosen sample size of 1000 follows the example of Tonsor *et al.* (2011: 398) in their cross-country study using panel surveys in Canada, Japan and the United States.

The sampling strategy for the surveys involved recruiting participants from an online panel database of consumers provided by an international market research company for each of the five countries (see Callegaro *et al.*, 2014a and 2014b, for discussions of the strengths and weaknesses of using panel databases). These survey panels are profiled, broadly recruited and frequently refreshed by the company. The respondents for each survey are recruited by online marketing. The company holds a participation history of each panel member. Each respondent who completes the survey is compensated with a retail voucher. Each survey was stratified by the country's age, household income distribution and occupation of the chief income earner of the household. The survey was prepared in English. For the Chinese, Indonesian and Japanese surveys, the questionnaire was translated into the respective language by a professional translation service and cross-checked by other translators.

Potential survey respondents were screened out for low income, for not going grocery shopping at least once a month, and for not knowing New Zealand as a country. The motivation for this screening was that imports from New Zealand are a small share of these large markets and so the study focused on market segments that might consume premium agri-food products from New Zealand. Thus, the surveys did not attempt to provide a representative or random sample of consumers (which is not generally feasible using opt-in panel samples; Baker *et al.*, 2010). The surveys were completed in all five countries during March and April 2015 to collect data on understandings of key credence attributes and sub-attributes; the analysis of these data is reported in Section 5 of this paper.

The surveys gathered information from respondents about the importance of attributes in the food they purchased for their households. The attributes were grouped in two categories. The first category includes the traditional characteristics of quality, price, food safety, nutritional value and health-enhancing benefits. The second category includes attributes associated with 'responsible innovation': environmental condition, social responsibility, animal health, animal welfare and traditional cultures. The question being explored was whether consumers in distant markets might value improvements in these attributes as a result of some (perhaps costly) change in production or processing practice.

The surveys also contained a choice experiment to assess consumers' willingness-to-pay for attributes of different types of food and beverages. Choice experiments are an important technique for evaluating consumer preferences (Bennet and Blamey, 2001; Grunert *et al.*, 2014; Hanley *et al.*, 2001; Miller *et al.*, 2015; Ortega *et al.*, 2012; Tait *et al.*, 2012; Tonsor, 2011); this research used the seven steps summarised by Bennet and Adamowicz (2001: 74): (1) clarification of the decision problem including context, policy framing and study objectives; (2) attribute and attribute level selection, paying attention to the relevancy of the attributes, measurability and causal possible relationships between them; (3) questionnaire development, appropriate framing questions and sample characteristics; (4) development of an experimental design using statistical techniques to select which choice sets to include in the choice experiment as experimental efficiency depends on selected attribute combinations; (5) considerations of sampling frame and the survey mode for the data collection; (6) preparing and analysing that data within a suitable econometric model; and (7) publishing key results, inference and useful implications.

The results of the choice experiments were then provided as inputs into the Lincoln Trade and Environment Model (LTEM) to determine the implications for New Zealand producer returns. LTEM is a multi-country, multi-commodity, partial equilibrium model based on the VORSIM model created in the United States (Roningen, 1997), extended by the AERU at Lincoln University to focus on New Zealand's main trading partners, exported products and domestic agricultural policies (Kaye-Blake *et al.*, 2008; Saunders and Çağatay, 2004). It covers 23 commodities and 21 countries, the European Union and the rest of the world. For each commodity in each country or region, there is a net trade identity and six behaviour equations

covering domestic supply, domestic demand, domestic stocks, the domestic producer price, the domestic consumer price and the trade price. The model allows the analyst to project a baseline scenario to 2024 based on current policies, and then to determine differences that would result in an alternate scenario. For this paper, the scenario was constructed on the assumption that all imported products (that is, not just from New Zealand) into the five analysed international markets captured the premiums identified in the choice experiments. The results from this trade analysis are presented in Section 6.

5. Importance of credence attributes

Respondents were asked to indicate on a five point scale how important they thought ten specific attributes are when shopping for food and beverages. The five point scale was: not at all important; unimportant; neutral; important; very important. The results are shown in Figure 2. Respondents were given the option of indicating 'don't know'; these respondents and those who did not answer this question are excluded from the data in the two figures. The answers are given linear weights, with: 0 for not at all important; 25 for unimportant; 50 for neutral; 75 for important; and 100 for very important. Figure 2 separates the results for the two categories of attributes in the study; the top graph shows the traditional attributes of quality, price, food safety, nutritional value and health enhancing, while the bottom graph shows the 'responsible innovation' attributes of environmental condition, social responsibility, animal health, animal welfare and traditional cultures.

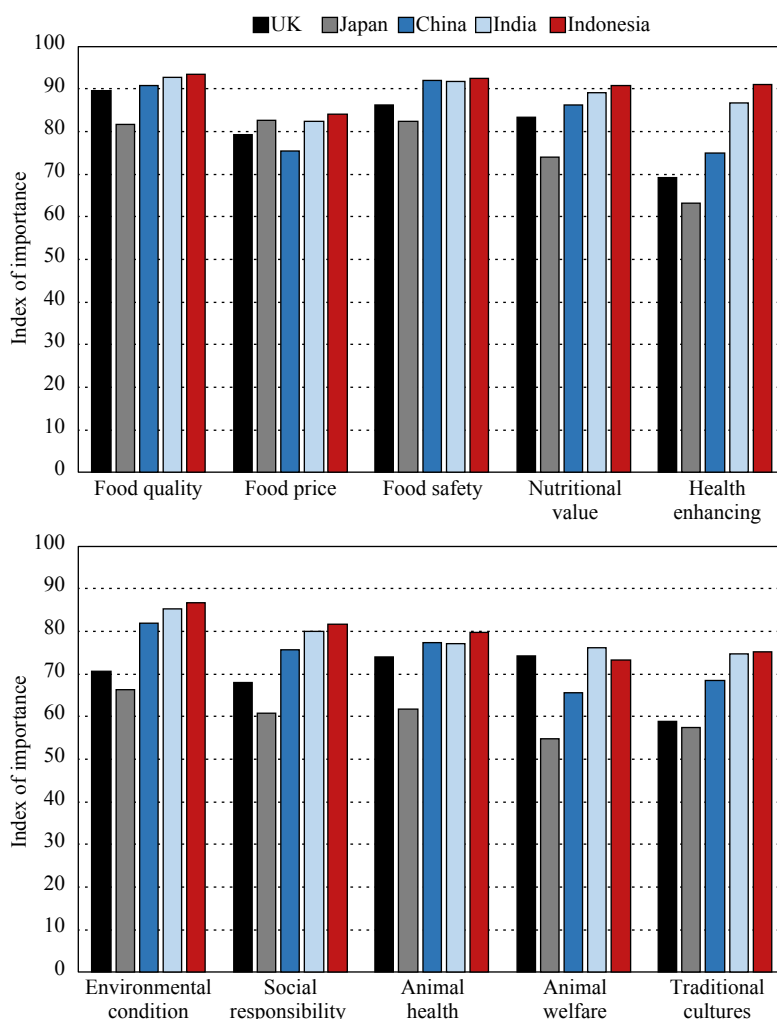


Figure 2. Importance of attributes in food and beverages, five selected countries, 2015 (Guenther *et al.*, 2015).

As expected, food quality and food safety had the highest values in every country, with nutritional value also ranking highly. This is consistent with previous research; see, for example, Lusk and Briggeman (2009), who reported that values of safety, nutrition, taste, and price were on average among the most important to consumers, whereas the values of fairness, tradition, and origin were among the least important. There was no indication in the data that consumers in the developing countries valued environmental condition, social responsibility, animal health or traditional cultures less than consumers in the United Kingdom and Japan. There was some evidence of environmental condition ranking highest of these attributes and of animal health being considered on average more important than animal welfare, except in the United Kingdom.

Survey participants were asked to rate the importance of different types of attribute authentication for food and beverages on the same five-point Likert scale. Authentication types included certification by a globally recognised certification scheme, by independent private verifiers, by the participants' own country's government, and by other governments. Other options were verification schemes from a brand, company, retailer or country of origin. The results are shown in Figure 3. The respondents' own country's government certification scheme was typically rated highest in importance. Globally recognised authentication was the second most important.

One of the purposes of the research was to investigate whether consumers in different markets have different understandings of the attributes considered above. This was explored in a series of questions about each

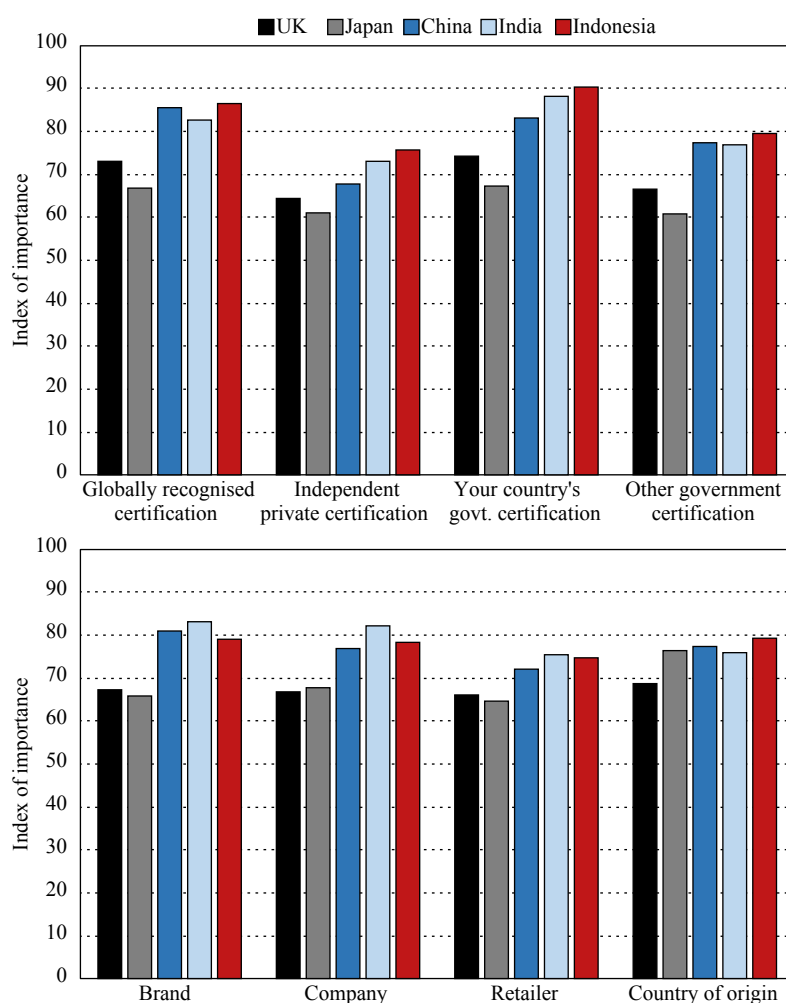


Figure 3. Importance of certification types, five selected countries, 2015 (Guenther *et al.*, 2015).

attribute; this paper presents the results for food safety to illustrate. This example is chosen because it is sometimes considered that this quality is the most important credence attribute sought by consumers, so that qualities such as environmental concern and animal health or welfare need not be emphasised. This study suggests that the contrast is not clear-cut.

Participants in the survey were asked to rate the importance of the following 12 factors underpinning food safety in the supply chain: hygiene standards; rates of contamination; freshness; labelling of 'use by date'; trust in supply chain; traceability to origin; tamper-proof packaging; GM-free food; environmental condition; reduced use of pesticides; animal health; and animal welfare. Again this offers a mix of traditional attributes and 'responsible innovation', with the last four examples being the most closely associated with responsible innovation. The same five-point Likert scale was used, and again a linear weighting scheme was applied with 0 for not at all important to 100 for very important. The results are shown in the three graphs of Figure 4.

The expected sub-attributes of hygiene standards, rates of contamination, freshness and 'use by date' labels have the highest rankings, although the last of these seems less important in the two developed economies. Trust in the supply chain and traceability have similar rankings across all five countries other than Japan, while tamper-proof packaging appears particularly important in Indonesia. The environmental and animal factors also scored highly, particularly in the developing economies. This suggests that these attributes can reinforce judgements around food safety and so should not be ignored in the marketing campaigns of agri-food exporters (see Van den Heuvel *et al.*, 2007, for an analysis of how sensory judgments and credence attributes jointly influence consumer perceptions).

6. Impact on returns

The results reported in Section 5 indicate a potential to obtain a price premium for products offering enhanced credence attributes valued by consumers. To determine whether this could increase returns to New Zealand producers, the researchers included a choice experiment in the surveys to draw inferences on consumer willingness-to-pay for five credence attributes (health-enhancing benefits, environmental condition, animal welfare, food safety, social responsibility). Respondents were presented with a series of choices involving three different products within a certain class (for example, three meat products, or three dairy products); in each case, one of the products was said to have minimum standards for all attributes (the five credence attributes plus a sixth attribute labelled as quality), while the other two producers were said to have combinations of standards that were minimum, improved or high. The three products had different prices and the respondents were asked to consider how the price of the product would fit in their grocery budget when indicating which of the three products they would prefer.

The results from the choice experiment are reported in Table 1 for the case where an attribute is improved from 'minimum' to 'improved'. The table shows the median percentage increase in willingness-to-pay, excluding outliers and negative results. There is a reasonable number of cells where these data did not reveal any potential premium, but for some attributes for some products in some countries, the increased willingness-to-pay could be up to 56% (for food safety of meat products in India).³

The data in Table 1 were transferred to the LTEM, where they were applied to all imports in each of the five countries. This means the modelled premiums gained for each attribute are not captured solely by New Zealand exporters. The advantage of using the trade model is that it allows dynamics between trading partners in the global market to be included in the analysis, as well as elements such as the size of the consumer base in each country, differing trade policies, and the extent of New Zealand exports into each market. Thus,

³ A referee comments correctly that the differences in how the different agri-food products score on the five credence attributes cannot be the result of geographical distance, which is constant for all groups (see also footnote 1 above). It would be interesting to explore reasons for these differences, but this was not the focus of the present study. The referee suggests it is possible that the issues raised by Blok and Lemmens (2015) may need more careful attention and may differ across different agri-food groups.

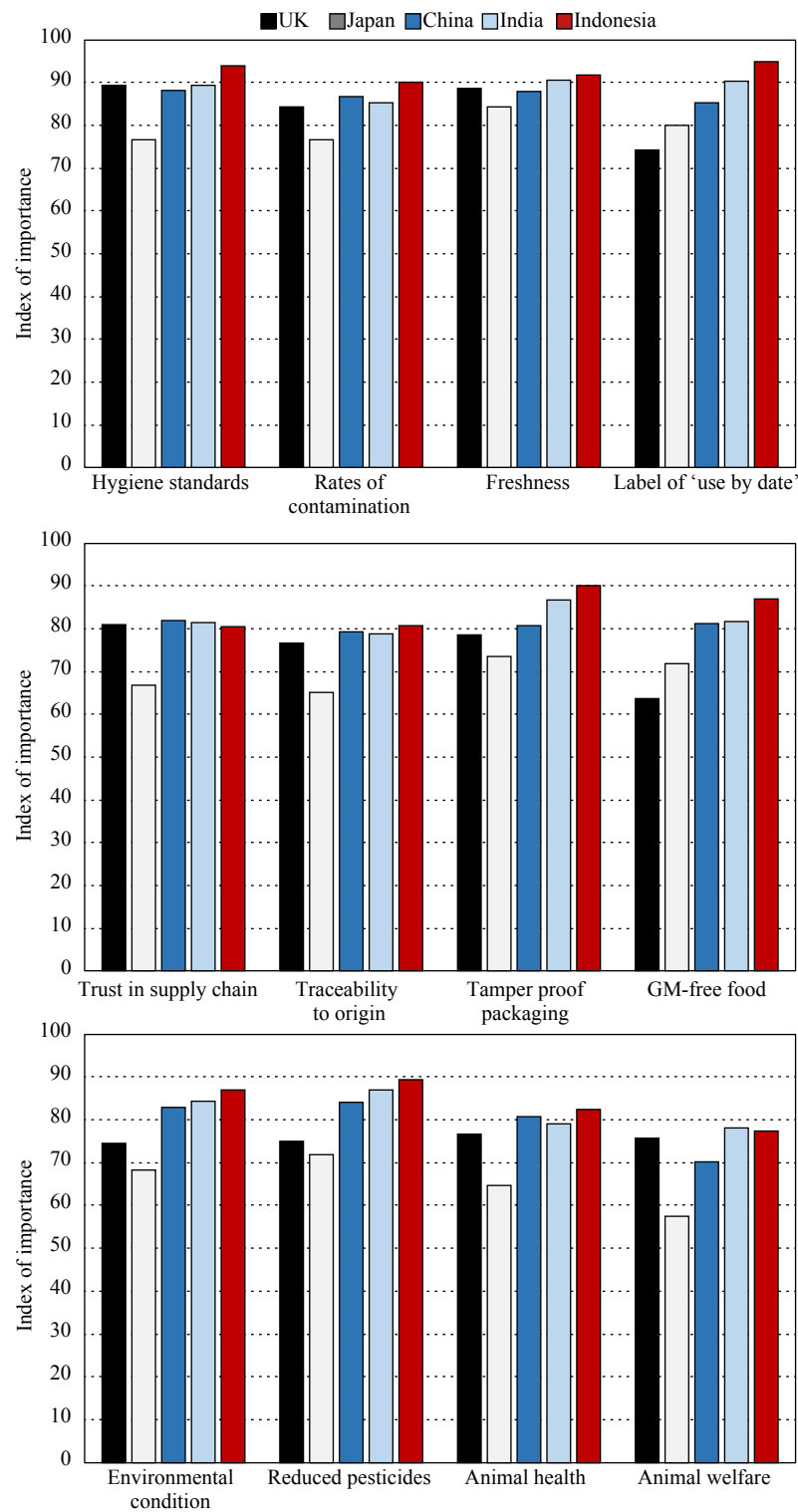


Figure 4. Importance of factors in relation to food safety, five selected countries, 2015 (Guenther *et al.*, 2015).

Table 1. Median willingness-to-pay for five credence attributes from minimum standards to improved standards for five countries and four agri-food products (%), 2015.¹

		Health enhancing	Environment condition	Animal welfare	Food safety	Social responsibility
China	Meat	8	–	4	2	–
	Dairy	–	–	7	3	–
	Vegie	–	–	3	–	–
	Wine	–	–	5	2	–
India	Meat	–	–	37	56	48
	Dairy	–	–	22	18	–
	Vegie	–	–	–	16	17
	Wine	23	–	–	–	–
Indonesia	Meat	12	16	13	16	–
	Dairy	–	16	6	17	–
	Vegie	14	–	5	15	19
	Wine	–	–	–	32	46
Japan	Meat	–	–	11	3	–
	Dairy	–	30	32	8	–
	Vegie	10	22	25	12	30
	Wine	30	–	12	3	–
UK	Meat	–	15	7	4	14
	Dairy	5	11	5	4	12
	Vegie	10	–	6	4	16
	Wine	10	3	6	1	10

¹ In the survey it was made clear that animal welfare includes biodiversity.

consumers in a market may have a high willingness-to-pay for a particular attribute, but this will not have a large impact on producer returns if that country has high tariff barriers.

The results of the trade model analysis are shown in Table 2. The data in each cell shows the impact on New Zealand producer returns if all imports of the relevant product to the five countries achieve the price premium shown in Table 1. The modelling shows that the overall impact of increasing the standard of any attribute from 'minimum' to 'improved' is positive for New Zealand producer returns, but they are not unreasonably large. The highest total increases from these results come from raising 'animal welfare' with a total 2.6% increase in total producer returns.

Of changes for individual commodities, all changes are positive with the exception of whole milk powder for two of the attributes. These exceptions are due to the increases in the willingness-to-pay for these attributes in dairy products being concentrated in the European Union, which is a net exporter of whole milk powder. The largest increases in percentage terms are for wine, where producer returns increase by more than 15% for improved health enhancing and social responsibility attributes. On this analysis, cheese and sheep meat also have relatively large potential for increases in producer returns. The results of this modelling exercise indicate that if New Zealand agri-food products were able to capture price premiums in its key export markets, returns could be increased depending on the commodity and targeted attribute.

Table 2. Modelled increase in New Zealand producer returns for improved accreditation for five credence attributes (% change from baseline), in 2024.¹

	Health enhancing	Environment condition	Animal welfare	Food safety	Social responsibility
Wheat	0.4	0.4	0.5	0.4	0.5
Other grains	0.7	0.9	1.1	0.9	1.1
Maize	0.7	0.9	1.1	0.9	1.1
Cereals	0.6	0.7	0.8	0.7	0.9
Beef	2.3	3.6	5.0	4.7	5.6
Pig meat	4.8	3.3	4.2	2.3	3.0
Sheep	4.9	2.7	9.3	10.7	9.3
Poultry	2.9	3.7	5.8	5.7	6.0
Raw milk	0.3	0.6	0.8	0.6	0.6
Butter	0.6	1.3	4.2	3.4	1.1
Cheese	3.5	7.3	4.3	3.1	7.6
Whole milk powder	0.0	0.4	2.3	1.3	-0.1
Skim milk powder	2.1	6.4	5.6	4.1	3.3
Apples	4.3	0.6	4.1	2.1	5.2
Kiwifruit	2.4	0.6	4.4	0.9	3.3
Wine	15.3	4.4	10.2	1.9	15.3
Total agriculture ²	1.1	1.5	2.6	2.1	2.1

¹ In the survey it was made clear that animal welfare includes biodiversity.

² Total agriculture is the aggregate of all 23 modelled commodities, some of which are not presented individually.

7. Discussion

This paper began by recognising demands from citizens for responsible innovation, but also acknowledged the issues identified by Blok and Lemmens (2015) as inhibitors to its adoption in industry. The issues can be listed in summary form as follows: fundamental differences among multiple stakeholders; incentives for not sharing information with competitors; and limited human abilities to predict all innovation consequences. Taken together, these inhibitors demonstrate that responsible innovation is a costly process, which can be justified only if responsible innovation creates valued attributes that consumers are willing to pay for. In a closed economy, the citizens calling for responsible innovation and the customers paying the higher prices would be drawn from the same population, but this paper has considered the case of New Zealand where the bulk of agri-food production is destined for distant markets (Figure 1). The resulting high degree of separation between producers and consumers intensifies the issues raised by Blok and Lemmens, and so leads to concerns that domestic citizen expectations for responsible innovation could increase the costs of production to an extent that would harm the competitiveness of New Zealand agri-food exports in international markets.

The research reported in this paper has addressed that issue by investigating whether higher quality credence attributes from responsible innovation could generate higher revenue to cover the higher costs. This involved two steps. First, if New Zealand production and processing systems can claim scientifically validated credence attributes, are these attributes valued by its international consumers? Second, if these attributes are valued, would the associated increase in consumer willingness-to-pay increase returns to domestic producers in New Zealand? Based on the evidence presented in Sections 5 and 6, the answer to both research questions appears to be yes. Contrary to some views in New Zealand, this research found that consumers in developing countries tend to value credence attributes more than consumers in developed countries, perhaps because of lower trust in the local regulatory environment. The choice experiment and trade modelling analysis shows that meeting this demand for credence attributes could increase producer returns in New Zealand (even if

other countries obtained the same premiums for their products), thus providing a reward for responsible innovation in a setting where consumers are distant from producers.

It is important to reflect on the validity of these conclusions in the context of the wider research programme on responsible innovation (Cho and Trent, 2006; Cresswell and Miller, 2000). In particular, are the results consistent with the experience of industry? In the year that the research programme reported in this paper began (2012), the CEO of the New Zealand Merino Company, John Brakenridge, launched the Te Hono Movement (Brakenridge, 2016). Membership now includes more than 170 agribusiness leaders who have participated in one of several New Zealand Primary Sector Bootcamps hosted at Stanford University, representing more than 80% of New Zealand's primary sector exports. In its own words, 'Te Hono is a journey that is unlocking the potential that exists for New Zealand to be recognised as world leaders in innovation, reputation and trust' (Te Hono Movement, 2015: 2). Thus Te Hono is built explicitly on innovation that is responsive to reputation and trust. It defines success as 'sustainable value delivered over the long term by increasing margin and capturing value across the entire value chain, not just volume or commodity price' (Te Hono Movement, 2015: 5).

There are exemplars of New Zealand exports earning premiums above the world commodity price. The Zespri[®] kiwifruit brand is an often-cited example of how New Zealand enterprises have captured value through emphasising the sustainability attributes of their production, processing and distribution systems (Zespri International, 2015). This organisation is 'now recognised as the world leader in premium quality kiwifruit, managing 30% of internationally traded kiwifruit by volume, yet accounting for approximately two-thirds of global value' (New Zealand Government, 2012: 19). The results reported here build on that example by providing scientific evidence on how credence attributes tailored to the expectations of consumers in different markets can increase export returns in agri-food global value chains.

There is no suggestion that creating and capturing additional value through responsible innovation is easy. Two aspects of the difficulties can be highlighted. First, the results from this study confirm that different markets have different understandings of specific credence attributes of different agri-food products. This means that producers in New Zealand face challenges in tailoring their marketing efforts to specific market segments across the world. Success requires understanding how different consumers perceive responsible innovation and its resulting credence attributes in a product. This is a practical example of the first of the three key issues identified by Blok and Lemmens (2015). It illustrates the essential role of 'knowledge-intensive business services' in creating and sustaining successful enterprises (European Commission, 2012b; Muller and Doloreux, 2009).

Second, there is an issue about 'capturing value across the whole value chain' (Te Hono Movement, 2015: 5). The importance of understanding different types of global value chains has been recognised at least since Gereffi's (1994) distinction between producer-driven and buyer-driven value chains. More recently, Humphrey (2006) has described increasing complexity in global agribusiness value chains. Fearne *et al.* (2012), Petrovici *et al.* (2012) and Soosay *et al.* (2012) have described how value chain analysis can expose strategic and operational misalignments that offer opportunities for additional value and economic sustainability. Particularly relevant is the recent report by the Value Chain Management Centre at the Canadian Agri-Food Policy Institute, which distinguishes four types of international agribusiness value chains: fragmented, cooperative, coordinated, and collaborative. That report concludes that 'when a value chain fails to reach its potential, the cause is most typically because the partners did not ensure the chain's structure and management processes reflected their target consumers' perceptions of value' (Value Chain Management Centre, 2012: 24). Thus, in order for responsible innovation to be financially feasible, further research is required to understand how credence attributes can be marketed to consumers in identified market segments through global value chains that increase returns to producers and processors.

8. Conclusions

Industry commentators have described a fundamental shift taking place in the food industry in response to consumer-led demand for safe, high-quality food they can trust (PwC, 2016). This suggests that responsible innovation will be an important feature of agribusiness as producers are motivated to communicate to their consumers the environmental, animal welfare, social and cultural standards of their production systems. The contribution of this paper has been to apply three inhibiting factors identified by Blok and Lemmens (2015) in a Netherlands case study to New Zealand's primary sector that has three unusual features. First, the primary and processing industries contribute an unusually high proportion of national gross domestic product for a developed country. Second, a small local population means an unusually high proportion of New Zealand's primary production is exported. Third, the country's long distance from the high income markets of the northern hemisphere creates an unusually high degree of separation between producers and consumers. Nevertheless, the research reported in this paper provides evidence that the final consumers of agri-food products in five of New Zealand's key export markets do value credence attributes that can be enhanced by responsible innovation, which has the potential to increase returns to domestic producers. A national movement of New Zealand agribusiness leaders is pursuing this vision, but this paper has concluded that further research is needed to understand how managers and business leaders within global agribusiness value chains can improve their responsible innovation actions (Saunders *et al.*, 2016b). This research will need to address the issues identified by Blok and Lemmens, but has the potential to demonstrate how returns can be increased for producers who successfully adopt responsible innovation processes.

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